The Association of Race/Ethnicity, Socioeconomic Status, and Physician Recommendation for Mammography: Who Gets the Message About Breast Cancer Screening?

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ABSTRACT

Objectives. This study investigated the association between physician recommendation for mammography and race/ethnicity, socioeconomic status, and other characteristics in a rural population.

Methods. In 1993 through 1994, we surveyed 1933 Black women and White women 52 years and older in 10 rural counties.

Results. Fifty-three percent of the women reported a physician recommendation in the past year. White women reported recommendations significantly more often than did Black women (55% vs 45%; odds ratio = 1.49). Controlling for educational attainment and income eliminated the apparent racial/ethnic difference. After control for 5 personal, 4 health, and 3 access characteristics, recommendation for mammography was found to be more frequent among women who had access to the health care system (i.e., had a regular physician and health insurance). Recommendation was less frequent among women who were vulnerable (i.e., were older, had lower educational attainment, had lower annual family income).

Conclusions. Socioeconomic status, age, and other characteristics—but not race/ethnicity—were related to reports of a physician recommendation, a precursor strongly associated with mammography use. Efforts to increase physician recommendation should include complementary efforts to help women address socioeconomic and other barriers to mammography use. (*Am J Public Health.* 2001;91:49–54)

Black women have higher rates of breast cancer mortality than do White women.[1] Later stage at diagnosis accounts for a proportion of the increased breast cancer mortality among Black women, and lower mammography use among older Black women helps explain some of the racial/ethnic difference in stage at diagnosis.[2,3] In studies that used Medicare data, older Black women less often used mammography, even after adjustment for age, income, and number of primary care visits.[4,5]

Physician recommendation to obtain mammography, which has been consistently and strongly associated with women's use of mammography,[6–9] could account for some of the racial/ethnic difference in mammography use. Only 50% to 80% of women 50 years and older reported physician recommendation for mammography in the past year, and it is unclear why some women receive a recommendation and others do not.[9–16] Physicians have identified cost to the patient as a major reason that they do not recommend mammography, and doctors may not recommend mammography to women who they think cannot afford it or will not comply.[14,17–21]

Although many investigators have examined factors related to mammography use, fewer have investigated factors associated with physician recommendation to obtain mammography. In this study, we used self-reported data from the North Carolina Breast Cancer Screening Program to investigate the association between physician recommendation and women's race/ethnicity, socioeconomic status (SES), and other characteristics in a diverse, mostly rural population.

Methods

Setting

Funded by the National Cancer Institute through the University of North Carolina Specialized Program of Research Excellence in Breast Cancer, the North Carolina Breast Cancer Screening Program is an 8-year controlled trial to increase mammography use among Black women 50 years and older. The trial is being done in 10 eastern North Carolina counties with a 1990 total population of 280 659. In these counties, 67% of the adults live in rural areas or small towns, 37% are minorities, and 12% are below the poverty line.

Data and Data Collection

Data for this study came from the 1993 to 1994 baseline survey of 2000 women 50 years and older, which included 2 cohorts of Black

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women (500 from 5 intervention counties, 500 from 5 comparison counties) and 2 analogous cohorts of White women (500 intervention, 500 comparison). Within a cohort, each county was represented proportionally.

Cohort selection occurred in 2 stages. First, based on 1990 US census data, we used a systematic random sample to select census tract blocks in each county. Interviewers then canvassed door-to-door to identify households that included 1 or more women 50 years and older without breast cancer. Overall, staff canvassed 520 census tract blocks and identified more than 3100 potentially eligible households. In approximately 10% of these households, women refused to participate or could not be contacted.

Second, within each county, we randomly selected households. If a household contained more than 1 eligible woman, 1 was randomly selected. Interviewers attempted to approach 2441 women, including 145 women who were ineligible because they were too ill to participate, had moved, had died, or had developed breast cancer. For the remaining 2296 women, interviewers completed 2000 interviews (interview response rate=87%). Response rates did not differ by county. Participants and nonparticipants did not differ by race/ethnicity or other demographic characteristics. For this study, we limited analyses to 1933 women 52 years and older to ensure opportunity for compliance with expert recommendations that women 50 years and older receive mammography screening every 1 to 2 years.

Trained interviewers visited women in their homes to administer a 45-minute questionnaire. Because women were more likely to respond to their peers, the 58 female interviewers were community members, and all but 2 of them were of the same race/ethnicity and approximate age as the women interviewed.

TABLE 1—Study Sample Characteristics: North Carolina Breast Cancer Screening Program, 1993–1994

	All Women, %[a]	By Race/Ethnicity[a] Black, %	White, %
Personal			
Age, y			
52–64	46	48	45
65–74	32	29	34
≥75	22	23	21
Married**	53	37	60
Educational attainment**			
Grades 1–8	21	35	15
Grades 9–11	23	33	18
≥High school	56	32	67
Annual family income ≥$12 000**	52	26	65
Health			
Personal history of breast problems**	20	8	26
Family history of breast cancer*	10	8	11
≥1 Medication taken regularly	83	81	83
Ever requested a mammogram**	15	10	17
Access			
Has a regular physician*			
Regular physician, obstetrician-gynecologist	4	3	9
Regular physician, not obstetrician-gynecologist	87	87	86
No regular physician	9	10	5
Has health insurance**	91	83	95
No. of medical visits in the past year**			
≥4	66	59	69
1–3	28	34	26
0	6	7	5

[a]Weighted by race/ethnicity, county, and age. Weighted "N" for all women ranged between 1920 and 1938. For Black women, weighted "n" ranged between 619 and 628; for White women, weighted "n" ranged between 1301 and 1310.
*$P \leq .05$; **$P \leq .001$.

Physician Recommendation, Mammography Use, and Women's Characteristics

The primary outcome was women's self-report of a physician recommendation for mammography in the past year. Interviewers asked women whether a health care provider (nurse or doctor) had reminded them to get a mammogram or breast x-ray during the past year. Because fewer than 1% of the women reported nurses as their primary provider, we considered all provider recommendations to be physician recommendations. Interviewers also asked women whether they had had a mammogram in the past 2 years. Women who had not heard of mammography (which we defined as an x-ray of the breast taken by a machine that presses against the breast while the picture is taken) were classified as not having had a recommendation or a mammogram. On the basis of the literature, we examined 12 self-reported women's characteristics that were potentially related to physician recommendation, including race/ethnicity plus 4 personal, 4 health, and 3 health care access characteristics (Table 1).

Analysis

We used reduced monotonic regression to categorize 4 variables that were continuous or had multiple response categories.[22] By regressing each characteristic separately on physician recommendation and establishing categories that strictly increased or decreased the proportion reporting physician recommendation, this method avoided the information loss or marked overfitting often associated with other approaches to categorizing variables. The method grouped educational attainment, annual family income, and the number of medical visits in the past year into 3 categories and the number of medications taken regularly into 2. After further analysis with a backward elimination regression method, we reduced the annual family income variable to 2 categories. Because 439 women (23%) did not report annual family income, we used multiple random imputations for missing values.[23] Multiple imputation permitted calculation of confidence intervals (CIs) that accounted for uncertainty caused by the imputation. Results from the analysis using reported and imputed income did not differ significantly.

To characterize the women and obtain population estimates of physician recommendation in the 10 counties (Table 1), we weighted sample data by county, race/ethnicity, and age. Subsequent analyses were not weighted. We used bivariate analyses (χ^2, t tests) to examine women's characteristics associated with physician recommendation and race/ethnicity. We then used multiple logistic regression models to investigate racial/ethnic differences in physician recommendation by examining the effects of controlling for various characteristics on the odds ratio (OR) for race/ethnicity. A final model controlling for all variables and the predicted probabilities from that model were used to investigate women's characteristics related to physician recommendation.

In addition, we used generalized estimating equations to adjust for potential correlation among respondents caused by having the same physician or living in the same census

tract block. Because generalized estimating equations and multiple logistic regression parameter estimates did not differ significantly, we present estimates from the logistic regression models. All analyses were conducted with the Statistical Analysis System, Version 6.12 (SAS Institute Inc, Cary, NC).

Results

Mammography Use and Recommendation

Among women 52 years and older in the 10 counties, 53% reported a physician recommendation for mammography in the past year, and 61% said that they had had a mammogram in the past 2 years. Compared with Black women, White women significantly more often reported physician recommendation (55% vs 45%; unadjusted OR = 1.49, 95% CI = 1.24, 1.78) and mammography use (66% vs 48%; unadjusted OR = 2.13, 95% CI = 1.77, 2.56). After all 12 personal, health, and access characteristics were controlled for, women reporting a physician recommendation in the past year were significantly more likely to have had a mammogram in the past 2 years (OR = 16.11, 95% CI = 12.37, 21.00).

Race/Ethnicity, Socioeconomic Status, and Mammography Recommendation

Approximately one third of all the women were Black, and about half reported indicators of low SES (Table 1). Black women significantly more often reported lower SES (educational attainment, annual family income). White women more often reported having access to the medical care system (regular physician, health insurance, more medical visits), as well as having a personal history of breast problems or a family history of breast cancer.

We used a series of logistic regression models with physician recommendation as the outcome to examine the effect of controlling for women's other characteristics on the odds ratio for race/ethnicity. In the unadjusted model, the odds ratio for race/ethnicity was 1.49 (95% CI = 1.24, 1.78), suggesting that White women were more likely to report a physician recommendation than were Black women. Controlling for educational attainment and annual family income eliminated the racial/ethnic difference (OR = 1.05; 95% CI = 0.86, 1.28). Controlling for other characteristics (but not for education and income) generally diminished but did not eliminate the racial/ethnic difference (ORs = 1.22–1.38).

TABLE 2—Physician Recommendation, by Study Sample Characteristics: North Carolina Breast Cancer Screening Program, 1993–1994

	Physician Recommendation	
	N[a]	% Yes[a]
Personal		
Age, y*		
52–64	774	56
65–74	664	50
≥75	495	39
Race/ethnicity*		
White	968	55
Black	965	45
Marital status*		
Married	892	56
Not married	1038	45
Educational attainment*		
Grades 1–8	509	35
Grades 9–11	479	48
≥High school	925	59
Annual family income, $*		
≥12 000	849	61
<12 000	1061	41
Health		
Personal history of breast problems*		
Yes	313	71
No	1620	46
Family history of breast cancer		
Yes	195	50
No	1738	50
No. of medications taken regularly*		
≥1	1588	52
0	342	37
Ever requested a mammogram*		
Yes	255	64
No	1678	48
Access		
Has a regular physician*		
Regular physician, obstetrician-gynecologist	65	83
Regular physician, not obstetrician-gynecologist	1676	52
No regular physician	183	17
Health insurance*		
Has insurance	1736	51
No insurance	192	35
No. of medical visits in the past year*		
≥4	1233	56
1–3	572	44
0	113	11

[a]Unweighted. N's vary from those in Table 1 because of weighting.
*$P \leq .001$.

Characteristics Related to Physician Recommendation

Women reporting a physician recommendation differed significantly on 11 of 12 characteristics from women who did not (Table 2). After all characteristics were controlled for simultaneously in a multiple logistic regression model, 5 access and health characteristics—having a regular physician (especially an obstetrician-gynecologist), having health insurance, making more medical care visits, having a personal history of breast problems, and taking 1 or more medications—were positively associated with physician recommendation (Table 3). Three personal characteristics indicating vulnerability—increasing age, lower annual family income, and lower educational attainment—were negatively associated with physician recommendation. Ever having requested a mammogram tended to associate positively with recommendation.

Predicted Probabilities by Women's Characteristics

We used parameter estimates from the final multiple logistic regression model to calculate the predicted probability (expressed as a percentage) of recommendation in 24

TABLE 3—Characteristics Associated With Report of a Physician Recommendation for Mammography in the Past Year, From Multiple Logistic Regression Model: North Carolina Breast Cancer Screening Program, 1993–1994

	OR[a]	95% CI	*P*
Personal			
Age	0.97	0.96, 0.98	≤.001
White race	0.94	0.75, 1.17	.56
Married	0.91	0.72, 1.15	.44
Educational attainment			
Grades 1–8	0.56	0.42, 0.74	≤.001
Grades 9–11	0.79	0.61, 1.02	.07
≥High school	1.00		
Annual family income ≥$12 000	1.38	1.05, 1.81	.02
Health			
Personal history of breast problems	1.88	1.41, 2.50	≤.001
Family history of breast cancer	0.93	0.67, 1.29	.65
≥1 Medication taken regularly	1.36	1.02, 1.81	.04
Ever requested a mammogram	1.33	0.98, 1.80	.06
Access			
Has a regular physician			
Regular physician, obstetrician-gynecologist	12.83	5.73, 28.68	≤.001
Regular physician, not obstetrician-gynecologist	3.32	2.15, 5.13	≤.001
No regular physician	1.00		
Has health insurance	1.59	1.11, 2.28	.01
No. of medical visits in the past year			
≥4	5.76	2.97, 11.16	≤.001
1–3	3.85	1.98, 7.47	≤.001
0	1.00		

Note. OR = odds ratio; CI = confidence interval.
[a]Adjusted for all other characteristics.

categories defined by combinations of women's SES, personal history of breast problems, having a regular physician, and age. Lower SES included women whose educational attainment was 8 years or less and whose annual family income was less than $12 000. Higher SES included women whose educational attainment was high school or more and whose annual family income was $12 000 or more. Because in the final model the effects of the 4 selected characteristics were constant across a range of values for the other characteristics, to simplify presentation we calculated effects for women who were White, were married, reported no family history of breast cancer, took 1 or more medications regularly, had health insurance, made 4 or more medical visits in the past year, did not have a regular physician who was an obstetrician-gynecologist, and had never asked a medical person about getting a mammogram.

Across the 24 categories, predicted probabilities ranged almost 6-fold, from 14% (lower SES, aged 75 years, no personal history of breast problems, no regular physician) to 82% (higher SES, 55 years old, history of personal breast problems, regular physician). On average, moving from lower to higher SES increased the probability of receiving a recommendation by 20 percentage points (range = 15–22), whereas increasing age by 10 years decreased the probability by 6 points (range = 4–7). Probabilities for women with a regular physician were 27 points higher (range = 22–29) than those for women without one. Having a personal history of breast problems increased the probability of a physician recommendation by 14 points (range = 11–16).

Discussion

Across the 10 counties in rural, eastern North Carolina, about half of the women surveyed reported a physician recommendation for mammography in the past year. Although White women reported a recommendation significantly more often than did Black women, controlling for SES (education and income) eliminated that initial racial/ethnic difference. After all characteristics were controlled for, physician recommendation was higher among women who had access to or involvement with the medical care system and was lower among women who were vulnerable—older, lower income, and lower educational attainment.

Although access to and involvement with the medical care system was strongly and positively associated with report of a physician recommendation, vulnerability, as indicated by SES and age, had a greater effect on the rate of physician recommendation in this population. Only a minority of women reported indicators of limited access (e.g., <10% had no regular physician or no health insurance), whereas approximately half of the women reported indicators of vulnerability (e.g., 54% were 65 years and older; 52% had an annual family income of less than $12 000). SES also had a significant effect on the racial/ethnic disparity in physician recommendation. Approximately two thirds of the Black women in this study reported low educational attainment and family income, compared with only one third of the White women. Controlling for the racial/ethnic differences in SES eliminated the apparent racial/ethnic difference in recommendation.

Numerous studies have linked women's SES, cost, and other economic factors to lower mammography use,[4,24–28] but few have examined the relation between SES and physician recommendation. Physicians may recommend procedures to some patients less often because of cost or perceived likelihood of noncompliance.[29] A study that videotaped simulated patients found that physicians were slightly less likely to recommend cardiac catheterization to Black women.[30] Physicians also more often perceived Black women as having low SES and being less likely to comply with treatment, although the differences between Black and White women were small. In a study at 22 private primary care clinics in Minnesota, however, patients of low and high SES reported similar rates of physician recommendation for mammography, although women of low SES reported significantly less mammography use than did women of high SES.[31]

Women in this study lived in 10 counties whose total adult population in 1990 was 67% rural, 37% minority, and 12% below the poverty line. These results may not be applicable to more urban, more affluent, or less diverse communities. Because this study used self-reported data, bias in women's recall of physician recommendation may have affected study results. Systematic underreporting of recommendation by older women of lower SES would overstate the negative effects of age, education, and income. Because older women of lower SES report mammography use less often than do most other groups of women, an association between nonuse and failure to recall recommendation also would overestimate the negative effects of these characteristics on recommendation. Little is known about women's recall of physician recommendation. Although women's self-reports of mammography use overstate actual use, they are reasonably accurate for population-based studies, and accuracy does not differ significantly by age, race/ethnicity, or SES.[32–35]

Among the 22% of the women in this study who were 75 years and older, 39% re-

ported a physician recommendation for mammography. The appropriateness of breast cancer screening for this older age group of women has not been established.[36] Although this study included a significant number of older women, the negative effect of age on physician recommendation was consistent across the full age range.

Several studies have shown that women whose physicians are female or obstetrician-gynecologists are more likely to obtain mammography than are other women.[37–40] In this study, women whose regular physician was an obstetrician-gynecologist reported a physician recommendation more often than did other women, although fewer than 10% of the women reported that their regular physician was an obstetrician-gynecologist. Recommendation likely varies by physician characteristics and attitudes,[41] but this analysis was not able to consider physicians' characteristics other than specialty. Women's preferences for mammography also may affect physician recommendation of the procedure, but this study did not measure women's preferences.

A wide variety of physician-directed interventions have been effective in increasing women's use of mammography, presumably via increased recommendation.[42] Few studies, however, have been conducted in vulnerable, particularly low-income and rural, populations. Increasing rates of appropriate physician recommendation is probably not sufficient to increase mammography use by women in these populations.

Low SES and economic barriers likely affect mammography use via several pathways.[43] Physicians' perceptions about the cost of mammography, women's inability to pay, or women's compliance may reduce the likelihood of recommendation and, indirectly, the likelihood of use. Women's lack of resources, combined with cultural or attitudinal barriers and limited access to affordable mammography, may directly reduce the likelihood of use, both in the absence of a physician recommendation and following one.[44,45]

Interventions to increase appropriate physician recommendation must be accompanied by complementary efforts that help women overcome economic barriers to mammography use. Interventions must also be accompanied by outreach efforts that prompt women to obtain mammography, encourage women to talk with their physicians about referral for mammography, and assist women in overcoming barriers to compliance with physician recommendation for mammography. □

Contributors

All authors contributed to the writing, review, and revision of the paper. M. S. O'Malley and J. A. Earp planned, designed, and directed the study. J. A. Earp directed the North Carolina Breast Cancer Screening Program, which sponsored the study and provided the data. S. T. Hawley contributed to the study design and data analysis. M. J. Schell contributed to the study design and directed the analysis. H. F. Mathews assisted with questionnaire design and directed the data collection efforts for the North Carolina Breast Cancer Screening Program. J. Mitchell assisted with questionnaire design, directed sampling, and assisted with data collection.

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References

1. Parker SL, Davis KJ, Wingo PA, Ries LA, Heath CW Jr. Cancer statistics by race and ethnicity. *CA Cancer J Clin*. 1998;48:31–48.
2. Eley JW, Hill HA, Chen VW, et al. Racial differences in survival from breast cancer: results of the National Cancer Institute Black/White Cancer Survival Study. *JAMA*. 1994;272: 947–954.
3. McCarthy EP, Burns RB, Coughlin SS, et al. Mammography use helps explain differences in breast cancer stage at diagnosis between older black and white women. *Ann Intern Med.* 1998; 128:729–736.
4. Burns RB, McCarthy EP, Freund KM, et al. Black women receive less mammography even with similar use of primary care. *Ann Intern Med.* 1996;125:173–182.
5. Gornick ME, Eggers PW, Reilly TW, et al. Effects of race and income on mortality and use of services among Medicare beneficiaries. *N Engl J Med.* 1996;335:791–799.
6. Fox SA, Murata PJ, Stein JA. The impact of physician compliance on screening mammography for older women. *Arch Intern Med.* 1991; 151:50–56.
7. Rimer BK. Understanding the acceptance of mammography by women. *Ann Behav Med*. 1992;14:197–203.
8. Mickey RM, Vezina JL, Worden JK, Warner SL. Breast screening behavior and interactions with health care providers among lower income women. *Med Care.* 1997;35:1204–1211.
9. Zapka JG, Stoddard A, Maul L, Costanza ME. Interval adherence to mammography screening guidelines. *Med Care.* 1991;29:697–707.
10. Lane DS, Caplan LS, Grimson R. Trends in mammography use and their relation to physician and other factors. *Cancer Detect Prev*. 1996;20:332–341.
11. Saver BG, Taylor TR, Treadwell JR, Cole WG. Do physicians do as they say? The case of mammography. *Arch Fam Med*. 1997;6:543–548.
12. Weingarten S, Stone E, Hayward R, et al. The adoption of preventive care practice guidelines by primary care physicians: do actions match intentions? *J Gen Intern Med.* 1995;10:138–144.
13. Fox SA, Siu AL, Stein JA. The importance of physician communication on breast cancer screening of older women. *Arch Intern Med.* 1994;154:2058–2068.
14. Grady KE, Lemkau JP, Lee NR, Caddell C. Enhancing mammography referral in primary care. *Prev Med.* 1997;26:791–800.
15. O'Malley MS, Earp JA, Harris RP. Race and mammography use in two North Carolina counties. *Am J Public Health.* 1997;87:782–786.
16. Roetzheim R, Fox SA, Leake B, Houn F. The influence of risk factors on breast carcinoma screening of Medicare-insured older women: National Cancer Institute Breast Cancer Screening Consortium. *Cancer.* 1996;78:2526–2534.
17. Conry CM, Main DS, Miller RS, Iverson DC, Calonge BN. Factors influencing mammogram ordering at the time of the office visit. *J Fam Pract*. 1993;37:356–360.
18. Urban N, Anderson GL, Peacock S. Mammography screening: how important is cost as a barrier to use? *Am J Public Health.* 1994;84:50–55.
19. American Cancer Society. 1989 Survey of physicians' attitudes and practices in early cancer detection. *CA Cancer J Clin.* 1990;40: 77–101.
20. Fox SA, Klos DS, Tsou CV. Underuse of screening mammography by family physicians. *Radiology*. 1988;166:431–433.
21. Weinberger M, Saunders AF, Samsa GP, et al. Breast cancer screening in older women: practices and barriers reported by primary care physicians. *J Am Geriatr Soc.* 1991;39:22–29.
22. Schell MJ, Singh B. The reduced monotonic regression method. *J Am Stat Assoc.* 1997;92: 128–135.
23. Rubin DB. Multiple imputation after 18+ years. *J Am Stat Assoc.* 1996;91:473–489.
24. Breen N, Kessler L. Changes in the use of screening mammography: evidence from the 1987 and 1990 National Health Interview Surveys. *Am J Public Health.* 1994;84:62–67.
25. Calle EE, Flanders WD, Thun MJ, Martin LM. Demographic predictors of mammography and Pap smear screening in US women. *Am J Public Health.* 1993;83:53–60.
26. Blustein J. Medicare coverage, supplemental insurance, and the use of mammography by older women. *N Engl J Med.* 1995;332:1138–1143.
27. Makuc DM, Freid VM, Parsons PE. Health insurance and cancer screening among women. *Adv Data Vital Health Stat.* August 3, 1994;254.
28. Centers for Disease Control and Prevention. Mammography and clinical breast examinations among women aged 50 years and older—Behavioral Risk Factor Surveillance System, 1992.

MMWR Morb Mortal Wkly Rep. 1993;42: 737–741.

29. van Ryn M, Burke J. The effect of patient race and socio-economic status on physicians' perceptions of patients. *Soc Sci Med.* 2000;50: 813–828.
30. Schulman KA, Berlin JA, Harless W, et al. The effect of race and sex on physicians' recommendations for cardiac catheterization. *N Engl J Med.* 1999;340:618–626.
31. Solberg LI, Brekke ML, Kottke TE. Are physicians less likely to recommend preventive services to low-SES patients? *Prev Med.* 1997;26: 350–357.
32. Degnan D, Harris R, Ranney J, Quade D, Earp JA, Gonzalez J. Measuring the use of mammography: two methods compared. *Am J Public Health.* 1992;82:1386–1388.
33. Etzi S, Lane DS, Grimson R. The use of mammography vans by low-income women: the accuracy of self-reports. *Am J Public Health.* 1994; 84:107–109.
34. Zapka JG, Bigelow C, Hurley T, et al. Mammography use among sociodemographically diverse women: the accuracy of self-report. *Am J Public Health.* 1996;86:1016–1021.
35. Vacek PM, Mickey RM, Worden JK. Reliability of self-reported breast screening information in a survey of lower income women. *Prev Med.* 1997;26:287–291.
36. US Preventive Services Task Force. Screening for breast cancer. In: DiGuiseppi C, Atkins D, Woolf SH, eds. *Guide to Clinical Preventive Services.* 2nd ed. Alexandria, Va: International Medical Publishing; 1996:73–87.
37. Franks P, Clancy CM. Physician gender bias in clinical decisionmaking: screening for cancer in primary care. *Med Care.* 1993;31:213–218.
38. Kreuter MW, Strecher VJ, Harris RP, Kobrin SC, Skinner CS. Are patients of women physicians screened more aggressively? A prospective study of physician gender and screening. *J Gen Intern Med.* 1995;10:119–125.
39. Lurie N, Slater J, McGovern P, Ekstrum J, Quam L, Margolis K. Preventive care for women: does the sex of the physician matter? *N Engl J Med.* 1993;329:478–482.
40. Andersen MR, Urban N. Physician gender and screening: do patient differences account for differences in mammography use? *Women Health*. 1997;26:29–39.
41. Gemson DH, Elinson J, Messeri P. Differences in physician prevention practice patterns for white and minority patients. *J Community Health.* 1988;13:53–64.
42. Mandelblatt JS, Yabroff KR. Effectiveness of interventions designed to increase mammography use: a meta-analysis of provider-targeted strategies. *Cancer Epidemiol Biomarkers Prev*. 1999; 8:759–767.
43. Hawley ST, Earp JA, O'Malley MS, Ricketts TC. The role of physician recommendation in women's mammography use: is it a 2-stage process? *Med Care.* 2000;38:392–403.
44. Burack RC, Liang J. The acceptance and completion of mammography by older black women. *Am J Public Health.* 1989;79: 721–726.
45. Dolan NC, Reifler DR, McDermott MM, McGaghie WC. Adherence to screening mammography recommendations in a university general medicine clinic. *J Gen Intern Med.* 1995; 10:299–306.